Learning at Distance
Navigating with NASA

Developed by Genesee Intermediate School District
21st Century Community Learning Centers

So you would like to do some NASA activities with your after-school students (either virtually or in-person) but not sure where to start? NASA's website is a WEALTH of knowledge, but with so much information, it can be overwhelming to navigate the first time. This guide will take you through finding and using some great NASA STEM activities and resources, either for one-and-done activities or longer project-based lessons. There are also suggestions for how to do these activities either virtually, alone at home, or in-person.

Engineering Design Challenges

Choosing a Challenge

Engineering Design Challenges are more in-depth project-based challenges which can encompass several class periods. It is easiest to get to these challenges through the Y4Y website.

1) Sign into your Y4Y account. Don't have one yet? Sign up for free at https://y4y.ed.gov/ and click the sign in/join tab! You can explore this part of the site without an account as well.
2) Once you are signed in, go to STEM initiatives. Click the NASA Engineering and Design Challenges. You will see an overview of the program, 2 challenge choices for grades 3-5, and 5 challenge choices for grades 6-8 (although we have used them with high school as well- still fun to build!)
3) Clicking on one of the challenges will bring up a short summary before giving you a chance to click into the challenge.
4) Once in the challenge, scroll down to the columns: Plan Your Challenge and Deliver Your Challenge.
5) Click "The Challenge" and read through it. This is the culminating project- what the students will design and build.
6) Click the "Materials for Challenge". Depending on your program, you may be providing virtual students with some individual supplies. Several challenges can be done with a few key tools and then with "whatever you can currently find in your home" (I always make the disclaimer that students should ask first if they want to use something that is not theirs).

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7) Scroll down further and view the video introduction to the challenge. You will show this to students on the first day.
8) If the culminating project and the materials needed look good, then you are ready to delve into the project!

Planning Your Chosen Challenge

The full lesson plan for the challenge is found under the Educator Information tab on the Y4Y website. This document may seem a little overwhelming because of its length (usually over 30 pages), but fear not! Every challenge is set up in the same way with these main parts:

- Teambuilding (will look a little different virtually)
- Prior knowledge
- Leading Investigations (short experiments to teach science concepts before designing the project)
- Designing
- Building
- Testing
- Redesign/build/test
- Sharing/reflection

I have broken these main parts into 8 one hour sessions. More time can always be added into any phase if students are continuing and interested. I will now go through each session, where to find it within the Educator Information, and adaptations for facilitating socially distanced in-person or virtually.

Engineering & Design Challenge Sessions

Session 1: Challenge Video Intro, Team Building and Prior Knowledge

- An introduction video is found on the bottom of the Y4Y's main page for each challenge (you viewed it earlier to choose your challenge)
- Team Building is found on page 4 of the Educator Information
- Prior Knowledge is a few pages later under the title Engagement: Accessing Existing Knowledge
- The NASA Mission Background pages found in between Team Building and Engagement are great references to point students (and yourself) to if questions arise about the science behind the challenge.

Adaptations:

Video- share screen so all virtual students can view video together

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Team Building- Since students cannot work in groups closely, they can each design their own mission patch, either with pencil/paper or by drawing it on the Zoom whiteboard. Their designs can then be shared via Zoom camera or share screen. Live programs can social-distance show paper/pencil designs, explaining the details that may not be able to be seen from a distance. You can also encourage them to draw out to fill the whole page instead of a normal patch size.

Prior Knowledge- use the questions on this page to conduct a whole-group discussion, or, if virtual, use breakout sessions for smaller groups. You can also utilize the chat box so students who are quieter or don't like to speak on Zoom can still feel comfortable participating.

Session 2: Supporting Science Investigation 1 with Reflection

Each challenge has 2-3 Supporting Science Investigations, which are small experiments/activities/observations aimed at discovering the science concepts needed to succeed with the design challenge. These are meant to be DISCOVERY learning. It is best to do the activity, and ask questions along the way.

- The Supporting Science Investigations have a cover page called Exploration: Supporting Science Investigations right after the Prior Knowledge Page. The actual investigations are after that cover sheet.
- The Reflection questions are found after all the investigations (under "Investigation Discussion"), but I would use these questions during and after EACH investigation to check for understanding of key concepts.
- Copies for students are found in the Student Journal, along with places to record their findings. The student journal is on the Y4Y Challenge main page (where you found the video and the Educator Information links)

Adaptations

Supplies- Plan ahead for individual supplies for the investigation. If virtual, you may need to plan ahead to get students' supplies to them or to allow them time to gather supplies (like recycling)

Student Journals- may be printed off and mailed to virtual students, or could send an email or send a link. Students can record findings on scrap paper, and use a split screen to view the Zoom and the journal at the same time. In-person students could have individual copies of the entire journal, or just certain pages. These are meant to be tools! Questions can be discussed instead of written, especially with limited time or when there is a LOT of writing within a hands-on activity. At times students feel that in after-school programs, "too much writing" feels like school and you may lose student interest. Use if/when helpful to aid learning.

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Virtual Investigations- walk students through the activity. Ask them to leave their web cameras on as they work so you can observe and ask questions along the way

Team Investigations- all challenges are written to do the investigations in teams of 2 or more. Most will work individually, but you may need to make adjustments to some. Read through them before teaching, and make sure they can succeed on their own. Offer ideas (like tape one end of your measuring tape on the wall) to make it easier to do solo.

Session 3: Supporting Science Investigations 2 (and 3 if applicable) with Reflection

This will look the same as above, but with the next Supporting Science Investigation and Reflection questions. If there are 3 investigations, then they are usually shorter and two could be finished in an hour long class period.

Session 4: Design Day-Research

- After the Investigations Discussion pages, there are a few pages about the Engineering Design Process. You can screen share or draw out the diagram, if you wish. The main thing to stress is that you will fail! And that is good! You want your students to know failure is expected in engineering. When something doesn't work the way you intended, it helps you improve it.
- The Engineering Design Challenge page is next. This is the one you reviewed when choosing your challenge. Go over the challenge and explain what the words criteria and constraints mean. Explain the criteria (what you need to have to make a successful design) and constraints (the limitations you have, like mass, size, materials used, etc.) for this challenge.
- The Identify a Need or Problem will help guide you in explaining the challenge and includes questions to make sure students understand WHAT the challenge is and WHY it is important.
- Before starting to design, tell students they need to research the problem and what is currently being worked on. They may be able to draw ideas from others. This is not cheating. Scientists and Engineers often share ideas. You just need to credit where your idea came from! The Research page will help them do this. You will want each student to have a copy of "The Engineering Design Process: Research" page from the student journal.

Adaptations:

Team work- Since students are not working in small groups, it may be helpful to assign a research question to each student, then share out what was found.

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Virtual students could do a split screen search, then share screens to share out. Live students can research with ipads or computers and report out.

Supplies- ensure that all students have a device to conduct research and a copy of the questions

Session 5: Design, Share and Start to Build

- The Engineering Design Process-Design page in the student journal gives space to draw out their design, but this can also be done on any scrap paper.
- During this design time, remind students of the concepts they learned in the Investigations, the research they did, and the Criteria and Constraints of the challenge.

Adaptations:

Teamwork- virtual (over the web camera) and in-person social distancing students can share their design concepts. Students can give feedback: one strength and one possible issue. This will replace the Analyzing the Designs page in the Facilitator Guide. They are not working in teams, and do not have to find a shared design concept.

Redesign- once all students have shared and gotten feedback, give them a chance to re-design and incorporate other's design concepts into theirs. Remind them this is not cheating but collaboration!

Supplies- you can decide if you let students see the supplies to build with before OR after designing. You can also decide how many supplies (if any) you will provide for virtual students and plan how to get the supplies to them before this session so they are ready to build.

Session 6 & 7: Build, Test, Redesign, Test

- The Prototype page will be skipped in the virtual or social distanced setting. This page simply breaks up building tasks to the team members,but since they have to build individually, this willl not apply.
- Ask students to record what they did and how it worked. List any changes made and how that worked. They can use the sheets in the student journal (The Engineering Design Process-Test and Evaluate) or their own method of recording.

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Adaptations:

Virtual- Ask students to keep their web cameras on while building and testing. Ask how things are going. Ask them to put their camera up so you can see the testing. Be another set of eyes as they test. Ask questions like: “is that what you wanted it to do?” “What were you hoping it would do?” “What could you change to make that happen?”

Time- allow virtual students to continue improving on their designs on their own time before sharing out next week. You can add more Build/Test/Redesign sessions live, if needed.

Session 8: Share and Celebrate!

- The last pages of the Facilitator Guild talk about creating a video to share the team’s process. Since they are not actually working in teams (collaborating, but not teams) we can share out in other ways.
- Ask students to present their final design. Ask questions like:
    - What influenced your design?
    - Are there any ideas in your design you need to credit to someone else?
    - Did your prototype work how you wanted it to?
    - What changes/improvements did you make to the design?
    - How many times did you test before you got the current prototype?
    - Name one design triumph and one design opportunity.

Adaptations

Sharing- If virtual students all have media clearance, consider recording this Zoom session “Show and Tell” and providing a link to Y4Y. Students will have to change their names under their Zoom and not mention their school name for privacy reasons. This session could also be live recorded with social distancing in place.

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ONE DAY ACTIVITIES

1) Check out NASA's Jet Propulsion Laboratories website at https://www.jpl.nasa.gov/edu/learn/ This will take you to the student activities section.
2) Open one of the activities. These will give you step-by-step instructions.
3) For further class management ideas and ways to present the activity, click on the line that says: Educators, explore how to turn this into a standards-aligned lesson for students. This will take you to a new page which is a more detailed lesson plan, including an estimated time frame to teach the activity. These are a great resource for reflection questions to help guide student learning. Remember: YOU don't have to have all the answers! You are there to ask questions so they can figure things out on their own through the activity. You may not even know the answers at all, and that is okay! You are NOT expected to be a NASA scientist! You are there to encourage curiosity and guide towards ways to FIND answers. You may be finding answers alongside your students. It is WONDERFUL for them to witness lifelong learning!
4) You can filter your search by adjusting grade level, activity type, and topic from the main LEARN page.
5) Got that down pretty well? Go beyond the Activities tab on the LEARN page and explore another option: Toolkit, Contests, Learning Space (NASA at home)
6) Use this resource to craft your own NASA club or class!
7) There is much more to explore on NASA's website. This is just a good place to start to find great activities for your students!

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RESOURCES

You4Youth US Department of Education Online Professional Learning and Technical Assistance for 21st Century Community Learning Centers. Including STEM initiatives and NASA Engineering Design Challenges https://y4y.ed.gov/

NASA STEM Engagement—STEM activities for students and their families right at your fingertips. Launch rockets, build a hovercraft, create a winning science fair project and more! https://www.nasa.gov/stem-at-home-for-students-k-4.html.

NASA STEM at home for students grades 5-8 Participate in Fun NASA Activities https://www.nasa.gov/stem-at-home-for-students-5-8.html.

NASA STEM at home for Students Grades K-4. https://www.nasa.gov/stem-at-home-for-students-k-4.html.

NASA Video--Stream NASA Television including #AskNASA, mission video and more! https://www.youtube.com/user/NASAgovVideo

Teaching Space with NASA –Join NASA experts and education specialists for education webinars. Ask questions, get teaching resources and share the excitement of space exploration with students. Upcoming webinars scheduled each month through the end of the year and recordings of webinars from the past few months. No registration required unless you would like to be part of the amazing experience of joining the LIVE Q & A. https://www.jpl.nasa.gov/edu/teaching-space/.

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